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ORIGINAL RESEARCH PAPER

Evaluating total carrying capacity of tourism using impact indicators

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ABSTRACT: The carrying capacity is well identified tool to manage problems due to uncontrolled tourism for any destination. This report highlights the carrying capacity estimation of Kerwa tourism area, Bhopal, India. The methodology used in this report is a new two-tier mechanism of impact analysis using index numbers derived from a survey of 123 stakeholders. From this the individual component impact analysis and the total carrying capacity of the area is computed in order to state the insight of the total carrying capacity left for the tourism activities in Kerwa tourism area. It is calculated from, the results so obtained, that the Kerwa catchment area falls in "very low impact category" and hence in a healthy state of the artwork in terms of total carrying capacity. The study conveys the current need in the destination management and tourism development as a road map for the destination managers for implementing sustainable tourism.

KEYWORDS: *Carrying capacity; Impact assessment; Indicators; Tourism impacts; Tourism management*

INTRODUCTION

Tourism has become a major source of foreign exchange for India, and the historic homes and rich biodiversity in the central India are the major tourist centers of attractions among the visitors' visiting to research these fields. Undisturbed ecosystems, their works and animal communities are vital in holding the clean air, clear water and healthy environments that are key tourist attractions in many destinations (Buckley, 1999). Located at the top of the environmental and industrial chain, tourism is extremely sensitive to environmental conditions and to the impacts others have on the system. In fact, the state of tourism itself may be a key indicator of system stability. Tourism, a multifaceted economic activity, interacts with the environment in the framework of a two-way process. On one hand, environmental resources provide one of the basic 'ingredients', a critical production factor, for the production of the tourist products: the natural and/or man-made setting for the tourist to enjoy, live in, and relax, and on the other hand, tourism produces a variety of unwanted by- products, which are disposed, intentionally and unintentionally, to and modify the environment; the case of negative environmental externalities (Briassoulis, 1992). The rapid but unplanned exploitation and utilization of these resources create a risk of losing their recovery capacities, destroying the basic functionalities within tourism areas (Nghi *et al*., 2007). The concept of 'carrying capacity' as a guide to the management of tourism is of much interest. While it is useful to recognize limits to the carrying capacity of natural areas used for tourism, the concept is not a straightforward managerial tool. Dissimilar carrying capacities may apply to different characteristics of a tourism site and carrying capacities may not be discrete or defined (Tisdell, 1998). Despite these disqualifications, it is important to take into account the interactions between tourism and other variables at a site, such as the quality

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of its environment. Some sites may be ecologically so fragile or so sensitive to human intrusion, that tourism should not be allowed or should be severely restricted, especially if the site is required for scientific research that is incompatible with tourism. The concept of carrying capacity is very old in wildlife management, and was used for the first time by Dasmann in 1945 (Wall, 1983) for assessing the capacity of the forests for grazing by animals. In the early 1960s, the concept was applied recreationally for the purpose of determining the ecological disturbance from the use (Lucas, 1964; Wagar, 1964). Carrying capacity, as stated in the literatures can be vaguely defined as the sum-total of the productive and assimilative capacities of that particular ecosystem, in relation to its use. The natural environment has the capability of producing a given output flow of products and assimilating a given input flow of wastes. This balance defines the stress limits within which the system can compensate and still return to its original condition. The uncontrolled growth of tourists and tourism activities in the areas of natural beauty and historical significance is exhausting the very resources that transform an area into a tourist destination (Bhattacharya and Banerjee, 2003).Tourism carrying capacity has been widely used for guiding conservation and ecotourism related decisions, allowing recreational activities to be undertaken within natural areas in an orderly and systematic way that can generate least impact (Carr, 2000; Fraschetti *et al.,* 2002; Gossling, 2002; Coccossis and Mexa, 2004).

Carrying capacity is frequently quoted as a framework in which the aim of determining the scope of tourism in a destination can be achieved (Hunter and Green, 1995; Inskeep, 1991; O'Reilly, 1986; WTO, 1993). Luc,(1998) defined the tourism carrying capacity as "The maximum number of people that use tourism site without unacceptable effect on environmental resources while meeting the demand of tourists". The carrying capacity of a destination is determined (i) by its ability to absorb tourist development before negative impacts are felt by the host community, and (ii) by the level of tourist beyond which tourist flows will decline because the destination area ceases to satisfy and attract those (Saveriades, 2000). There are available various studies which proposes the establishment of carrying capacity approaches to mitigate the impacts due to specific tourism activities (Davies and Tisdell, 1995; Rios-Jara *et al*, 2013). The tourism carrying capacity recently has garnered attention and evidences, indicating that the tourism carrying capacity concept could be a part of a very effective strategy to address not only environmental questions but also economic and social issues (Davies and Tisdell, 1995; Coccossis and Mexa, 2004).Granting to the various definitions, the tourism carrying capacity consists of three components: ecological carrying capacity, social carrying capacity and economic carrying capacity (Nghi *et al,* 2007). The technique of carrying capacity is very pertinent and has special reference to for the protected areas for studying the interactions of the biotic pressure, ecotourism and ecosystem to maintain the natural sense of balance, and the wise and scientific purpose of bearing capacity can serve to be an efficient instrument for the management of PAs and sustainable ecotourism (Bhattacharya and Banerjee, 2003). Thus, the main objective of this study is to utilize the concept of carrying capacity as an assessment tool for the activities and impacts of tourism in a Kerwa destination area, Bhopal, India. It also focuses on developing an impact based indicator methodology to evaluate the total carrying capacity (TCC) for a tourism destination. The stakeholder survey was conducted in a planned manner as to cover all the visitors' season in Kerwa tourism area, Bhopal, India during the year 2006-2007.

MATERIALS AND METHODS

The methodology employed in the study is an integrated method for calculating the TCC is taken from the work of Bhattacharya and Sankar (2003). The methodology of Bhattacharya and Sankar used is further adapted from Battelle environmental evaluation system (BEES) used in environmental impact assessment (EIA) studies and limits of acceptable change (LAC) framework for the study of tourism research. The method employed in this study to quantify and evaluate tourism carrying capacity is a two- tier system, where the impacts are at first calculated for the individual indicators of components and then for the components itself, with an assumption that a tourist destination has a holding capacity of 100% before the action was started. The adverse impact of tourism activities reduces its carrying capacity and management initiatives can augment it (Sankar, 2003). The impacts of tourism on the indexes are at first evaluated by indicator quality unit (IQU) and multiplied by the proportional importance of each index in forecasting the impact by parametric importance unit (PIU). The indicators of tourism carrying capacity relevant for this purpose were identified through different tourism, environment and tourism management journals. Literature and studies conducted in the country linked to tourism and impact assessments were also conducted into account

to draw indicators relevant to the goal country. These indicators also present an estimation of threshold of visitors' that can be taken at the destination while considering the contents of some parts of the local tourism organization. This is based on the assumption that the number of people agreeing to the impact statement is directly proportional to the severity of impact. The PIUof each indicator is calculated from the arithmetic mean of scores given by experts based on the ability of the indicators to accurately predict the impact on the component. The experts were given the guidelines for rating as follows (Bhattacharya and Sankar, 2007a,b):

• High Importance- These are the indicators that directly indicate the impact as well as the chances that the occurrence is only due to tourism activity is also high. These impacts are directly observable and the cause effect relationship can be easily created.
• Medium Importance- These are also indicators that directly indicate the shock, but the prospect of tourism activity being the sole causative factor is doubtful. Thus, these indicators should be of medium importance.
• Low Importance- These indicators are indirect signs of an impact. They are not directly observable or quantifiable.

Once the data on the rating is collected, then the value was assigned to these ratings. A summation of the ratings of all the experts was done and the arithmetic mean is calculated. This will be the PIU of that indicator. Multiplying the IQU with PIU of each indicator will give the carrying capacity impact unit (CCIU) of that indicator. In the next phase, the summation of the CCIU for all the indicators will give the total carrying capacity impact unit (TCCIU) for that overall component of carrying capacity. Then the relative importance of each component in determining the total carrying capacity as component importance value (CIV) is multiplied to the individual CCIU of each component to get the specific carrying capacity left. Ultimately, the sum of all the carrying capacity percentages of the components will give the total carrying capacity remaining in the destination area with regard to tourism activity. The lower is the value, the greater is the impact caused. Thereby, setting standards for the total impact and compare it with obtaining percentage. The standards were set as per the study of Sankar, 2003 was as Table 1.

The percentage of carrying capacity and the standards obtained from the study can form the basis of formulating the management plans for individual

Table 1: The standard for impact category of carrying capacity

Percentage (%)	Category of impact on carrying capacity
0 - 20	Very high impact on carrying capacity
21 - 40	High impact on the carrying capacity
41 - 60	Moderate impact on the carrying capacity
61 - 80	Low impact on carrying capacity
81 - 100	Very low impact on carrying capacity

destination areas or PAs. Data collection and analysis- as per the new methodology used in this study, data were collected through design questionnaires, field visits, literature review and expert opinion survey through schedules as an instrument. Surveys and data collection for various stakeholders was conducted during the years 2006-2007. The respondents for the stakeholder survey were selected by the random purposive sampling method of survey by taking into consideration factors like purpose of visitation and their knowledge about the study area and impacts in general related to tourism activities. The stakeholders like local residents, visitors', entrepreneurs and tourism officials were selected randomly for survey within the 3km of the tourism concentrated area. Selection of local level indicators for each of the component to identify the impacts of tourism on the five components of carrying capacity was carried out. The indicators were selected after discussions with experts of tourism industry, ecology, academicians' and field visits to identify the indicators specific to the destination areas as per the relative importance index of the indicators. The methodology used in experts opinion poll is based on Delphi technique (Mitra and Chattopadhyay, 2003; Rowe and Wright, 1999) and modified as per the present study needs to identify the impact indicators and relative importance of each impact indicator in each component. The Delphi's method consisting of a series of rounds of the survey was administered to a panel of experts in the field of study. In the experts' opinion, panel was formed consisting of 30 members and most of them were specialists in ecology, environmental conservation, academicians, forest/ tourism officials and members of NGOs working on environmental issues. The opinion of experts' opinion was mainly taken to identify, assess and ranking of indicators for each component carrying capacity specific to the destination site. The survey, administered involves the formal and structured soliciting of expert opinion used in our study followed the technique of Mitra and Chattopadhyay, (2003) in their study Environmental conservation and demand for nature- based tourism in Arunachal Pradesh, India sponsored by the Environmental Economics Research

Committee (EERC), which is further followed by the technique of Green *et al.* (1990) in their assessment of Environmental impacts stemming from a tourism project in England.

The Delphi technique was preceded in three distinct stages namely preliminary stage, First round and Second round. First a Delphi panel was formed consisting of 30 members and most of them were specialists in tourism, ecology or environmental domain related to conservation. At the preliminary round of the Delphi technique, the experts' in the panel anonymously answer a few numbers of straight forward open- ended survey questions focused on identifying the possible impacts on the environment and on the local impacts due to tourism activities, and to categorize them as negative or positive impact as per their perception and expertise. The open- ended survey responses from the preliminary round are received and categorized to create a valid and reliable list of structured and Likert type- closed ended questionnaire items to be used for the first round of the Delphi survey poll. The basis of the questionnaire was also an extensive checklist of impacts of tourism on environment derived from a comprehensive literature survey and published work related to study from the area or near around, which was supplemented to the impacts identified by the experts'. For selecting indicators related research work (Bhattacharya *et al.,*2005; Sharma *et al.,* 2005; Sharma and Bhattacharya, 2014) from Kerwa and tourism destination areas in and around Bhopal along with literature review was taken into account. Having completed the preliminary survey, the first round questionnaire was drawn up. The same panel of experts is provided with the close- ended survey questionnaire developed from the responses from the preliminary round to get their expert opinions about the indicators and impacts. They were requested to rank them in the 5- point Likert's scale, where 1 implies 'No Impact', similarly, 2= Negligible impacts, 3= Marginal Impacts, 4= Moderate impacts and 5= Major Impacts as per their knowledge and experience. The first round Delphi survey allows the panel of experts to recommend changes and suggest additions and or deletions to the survey questions. At this step, the Delphi survey is also accompanied by an anonymous summary of the experts' responses from the preliminary round in categorized form as per the component and frequency of responses without stating the experts' details. The survey responses from the first round are received and analyzed to provide a comprehensive description of the experts' consensus and agreement on the indicators identified. The methodology for calculating scale rankings adapted to transform to Relative importance indices (Desai and Bhatt, 2013; Deeppa and Krishnamurthy, 2014) for each indicator, wherever used in the present study. Relative importance index (RII) is calculated for each of the indicators and ranked accordingly. The RII is derived to summarize the importance of each indicator was:

$$RII = \Sigma w / A * N$$

Where,

w= weighting as assigned by each respondent in a range from 1 to 5, where 1= No impacts, 2= Negligible impact, 3= Marginal impact, 4= Moderate impact and 5= Major impact;

A = Highest weight (here it is 5)

N = Total number in the sample. (For an experts' survey, it is 30 and for stakeholder survey = 123).

The RII is an indicator or measure of the likelihood or recurrence of the variable from the respondents' point of view. The index can, therefore, be used to determine the rank of each indicator (Deeppa and Krishnamurthy, 2014). The indicators are now arranged in categories under each component carrying capacity and further preceded to the expert panel members for the second or final round of the survey. In this round, a revised closed- ended questionnaire accompanied by a summary of findings from the first round for each indicator component are sent to the same expert member of the panel. At this final stage, experts' were requested to re-rank the indicators in the light of the first round results, if they perceived so. The results so obtained finally give the indicators list of impacts for each carrying capacity components to calculate the total carrying capacity of the destination site.

After the completion of Delphi rounds, a field based survey is conducted by designing questionnaires in light of the results of Delphi technique. Total 123 different stakeholders (consisting of visitors, local residents and local entrepreneurs) were surveyed using a questionnaire. The stakeholders were asked for their perception of the impact that has occurred on these indicators due to tourism activities in the area. The stakeholders are also asked to examine whether the indicators as ranked by the experts are agreeing to them or there is any deviation as per their perception. On the basis of their percentage of responses agreeing to the existence of impacts is taken into account in determining IQU. The percentage of agreement by the stakeholder was determined for each indicator on the

basis of percentage of people who recognize the impact of tourism on that specific indicator and respective quality of the indicator, greater the impact. If no respondents among the stakeholder survey say there is an impact on the positive indicator, the value of IQU value of "1"is given. If 1-10% of the people consider there is an impact, then the value assigned will be 0.9, similarly for 11-20% will be 0.8, 21-30% will be 0.7 and so on finally for 91-100% will get a value of IQU as zero (Bhattacharya and Sankar, 2007 a,b). It is based on the assumption that the impact is directly proportional to the number of people who recognize that there is an impact. For data analysis and interpretation, MS Excel and SPSS-20 were used wherever feasible for data analysis from the field and the expert opinion survey.

Study Area:(Kerwa catchment area)

Kerwa region endowed with scenic and aesthetic values is in close proximity to the concrete jungles of Bhopal, Madhya Pradesh, India. The area is close to Van Vihar National Park, Bhopal and has a tremendous tourism potential and has also an impact on the socio-economic condition of the villagers.

Location: Kerwa region is spread over an area of 50 sq. km. Limited within the north Latitude N 23 18' and longitudinal E 77 20' Kerwa region lies with *Mendora, Mendori, Sarotipura, Kekeriya, Ransundriya, Bhanpur, Daulutpur* and *Chichli* villages and around 22 km from Bhopal district headquarter.The forests found here is a Tropical Dry Deciduous forest, with teak plantations. The region holds a variety of wildlife. Different species of carnivorous and herbivorous are reported from this area. Wildlife visibility is not good, but people can see *Pavo cristatus* (Peacock), *Semnopethicus sp.* (Langur) etc. The position of water availability is not good during the pinch period. Many *nalas* flow from July to November. The river in the region is Kerwa River, which originates from Kerwa dam and flows to Mandideep. It holds water in pools in summer. Visitors' mostly from Bhopal visit the Kerwa region mainly in daytime on Sundays and Holidays. There are many spots of historical, archaeological and scenic interest. But at present they are neither preserved and the attempts showcase these to the tourists have also been very poor. Hence all tourists arriving are picnic makers, not hardcore wildlife enthusiasts, but few being adventure sports lovers. The influx of the visitors is also not as satisfactory to the region as the potentiality it has. It is estimated that the total number of visitors arriving at the place is approximately 80, 000 annually. The majority of the visitors arrive here at the rainy period while, minimum during the summer season due to the non- availability of the infrastructure to attract tourists to the area. Although the area has lots of places of tourists' interest nearby, but these are not fully explored. Some of the spots to mention are Dam area, *Sarotipura* cave temple,

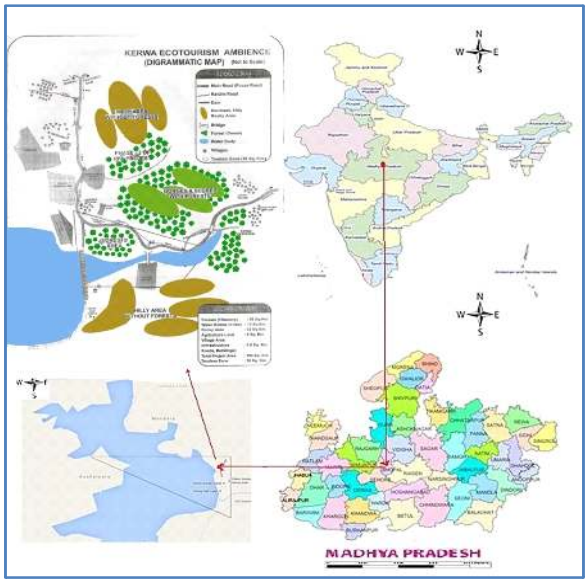

Fig. 1: Kerwa ecotourism ambience map

Pathankot cave paintings, *Reechan Khoh*, *Babajhiri* Religious centre, Nursery area and small dam. Kerwa catchment area has been developed as the major Ecotourism center for visitors' from the existence of Madhya Pradesh Ecotourism Development Board, Bhopal. The ecotourism related activities are the major attraction for the day visitors coming to the area for their leisure and recreation. The ecotourism ambience map of Kerwa area is given in Fig. 1.

Region's Natural Resources- Kerwa region has a Dam area, Kerwa Reservoir, Forest Area with a number of species of trees and shrubs, rich wildlife, Natural beauty and rock shelters. Paintings in the cave, which may belong to the Neolithic age, depict the life of the prehistoric cave dwellers. The natural resources in the area are being threatened due to visitors' activity in adjacent forest area, littering of waste and plastics, cooking in forest area are to state a few. Kerwa area is a major attraction for the tourists because it serves as a picnic spot with the scenic beauty. At present very few attempts have been made to quantify the impacts of tourism due to different activities.

RESULTS AND DISCUSSION

To assess the total tourism carrying capacity with regard to tourism activities in Kerwa catchment area, the first significant measure is to limit the packing capability of each component considering the possibility, recent and future impacts relevant to the field and then to estimate the importance value of each element in a consolidated ecological unit as CIV by the experts. The experts' opinion and results so obtained from the Delphi survey through sequential stages resulted in the categorization of indicators (Impacts) and makes a baseline questionnaire to compare with the tangible universe as on the field (results from stakeholder survey). The list of indicators and their impacts so identified has been listed in Table 2. The final list of indicators so identified from the experts' survey and implemented for stakeholders' survey is established along the descriptive and RII values for indicators in each class. Few of the indicators were omitted from the stakeholders' survey instrument, which were either ranked very low or are merged/ covered in other constituent. Later on the identification of impact indicator for each component unit, next important stage for the experts is to rank them according to their perception, expertise and familiarity with the study area in relation to ongoing tourism activities and the scenario. The base for the determination of component wise weight age of importance by the experts was the results obtained from the experts survey about the impacts on Likert's scale, where 1= No impacts, 2= Negligible impact, 3= Marginal impact, 4= Moderate impact and 5= Major impact. After the rating on Likert's scale, the arithmetic mean of different ratings as is given by the experts gives the final component importance value of each component (Table 3).

From the experts' survey and discussion, a sum of 28 indicators was finally identified for the different component sets considered and required for the cogitation. Further the stakeholders were asked for their perception of impacts that they perceive in their own belief due to tourism activities occurring in their area under five component heads in light of the experts rating and category component mentioned in the instrument. Further analysis was done accordingly to calculate the total carrying capacity of each component. The component sets were ecological carrying capacity, facility (Infrastructure) carrying capacity, Social carrying capacity, Economic carrying capacity and visitors' experience carrying capacity. The set of indicators under each component head and their impact quality unit (IQU) and carrying capacity impact value of each component was as follows: The total carrying capacity impact unit for ecological aspect as resulted from the step-by- step methods of estimation and calculation is 95.5 % or 0.955 (Table 4). The sign '+' and '-'as notation to each indicator shows that the positive or negative impact due to activity overall.

Likewise, the results of CCIU for Social aspect (Table 5), Facility/ Infrastructure aspect (Table 6), economic aspect (Table 7) and visitors' experience aspect (Table 8) was obtained to be 97.03%, 93.5%, 95.5% and 90.7 % respectively.

Thus, it is clear from the results of final CCIU value that the most effected component among the five of the Kerwa catchment area due to tourism activities is visitors' experience carrying capacity, which has been cut by approximately 10% considering if a total undisturbed condition is 100%. This can also be substituted by the fact that, most of the visitors' are not willing to visit site thereafter, which showed a break in their aesthetic appeal towards the station. The bottleneck of infrastructure and lack of visitors' general amenities like bathrooms, drinking water, proper maintained parking sites, and so forth, also adds to the unwillingness of visitors' another trip. The PIU value also so determined given in the overall relative importance of each impact indicator in the component and gives the insight that the under which criteria the destination manager has to focus so as to prepare a

Table 2: List of indicators and component categories identified by Delphi survey for Kerwa catchment area, Bhopal

Category of component	Indicators (impacts) identified
Ecological Impact Indicator	Solid waste accumulation and littering (-) Road degradation and vehicular traffic (-) Noise generation and pollution due to activities (-) Tourism has enhance scenic beauty (+) Promoted cleanliness and hygiene of the area (+) Encourages measures for the conservation of woodlands and wilderness areas. (+) Promoted more plantation campaigns and environmental awareness programs in the area (+) *Sewage, sanitation problems enhanced (-) *Loss of aesthetic value of the area (-)
Economic Impact Indicator	Tourism has created more jobs for the local people (+) Tourism in the area is responsible for additional income. (+) Tourism in the area has improved the standards of living of the residents (+) Inflation in price and increased cost of living in and around tourism zone. (-) *Jobs created by tourism in the area are often seasonal and poorly paid. (-) *Economic benefits leaks out away from local communities (-) *Demand for development of more shops, hotels etc. (-)
Facility Impact Indicator	Water or other natural resource scarcity (-) Site congestion or loss of aesthetic appeal (-) Locals' agitation and objections towards tourism in the area. (-) Legal restrictions for construction of hotels and other facility (+)
Social Impact Indicator	Enhanced functioning of local governing institutions (+) Facilitated contact with the outside world / culture sharing (+) Tourism has helped in preserving local art and culture (+) Problems caused by locals to visitors (-) Sufferance to local residents due to overcrowding, pollution, rash driving, water scarcity etc., by the visitors (-) Locals are losing confidence and cultural identity (-) Promoted crime, moral laxity/ drugs, eve teasing of local women etc., (-) *Improvement of infrastructure and new leisure amenities which benefits local communities (+) *Help raise global awareness of issues such as poverty and human right abuses (-)
Visitors' Experience Impact Indicator	Causes Solid waste accumulation, littering and alternation of landscapes of the area (-) Dust, Smoke and noise generation due to vehicular traffic in the area (-) Loss of aesthetic value of the area due to mass tourism (-) Mode of transportation and infrastructure amenities enhanced due to tourism activities at the area (+) Tourism facilities/ amenities has enhanced due to tourism in the area (+) Willingness for another visit to the area by the visitors (+)

* Implies that these indicators are not taken into consideration for Stakeholder survey, due to their very low rating by experts or arecovered/ mergedin some other component.

Table 3: Component Importance Value of Kerwa destination as given by experts for each component

Component	% Values given by experts (n=30)					Final CIV of each component
	1	2	3	4	5	
Ecological component	20.0	32.57	31.88	16.22	24.51	25.036
Social component	34.35	18.81	14.5	31.08	19.61	23.67
Facility (infrastructure) component	20.86	7.80	17.39	16.22	6.86	13.83
Economic component	16.96	16.05	10.86	14.49	15.68	14.81
Visitor's experience component	7.82	24.77	25.36	37.68	33.33	25.79

sustainable development plan of the area. For example, considering the negative impacts under the ecological carrying capacity component, the major area to focus while constituting sustainable development of the area will be a solid waste accumulation and littering problem due to leftovers by the visitors. Similarly, locals confidence and participation in the tourism and tourism activities in the area, water and natural resource scarcity both for locals and visitors as a amenities and infrastructure opportunity, stagnation of tourism activities and vehicle traffic and congestion along with loss of aesthetic appeal under their respective components can be the issues that have to be taken into consideration while implementing site specific developmental policies for the area.

The present study thus provides the set of indicators that will help to recognize on- going problems and purpose corrective actions and pin- pointing negative impacts under each component which hinders the development of tourism activities. But overall, the result so obtained ensures that each component carrying capacity is in its healthiest state accordingly to the standards set for the study lies in the low impact on carrying capacity category, but the issues so captured

has to be taken into account in managing the destination area in general and for all the other nearby tourism circuits. After the determination of TCCIU for each component, the component importance value that is already determined by the expert survey analysis is used in calculating total carrying capacity as is given by the experts' and the final carrying capacity left for tourism activity for each component as shown in Table 9.

Thus, the total perceived decline of carrying capacity for tourism activities as found by the new methodology for Kerwa catchment area for tourism activities is calculated to be 97.33%. According to the

Table 4: Indicator quality unit and carrying capacity impact unit of ecological carrying capacity component

Ecological impact indicators	Stakeholder agreement (%)	IQU	PIU	CCIU
Solid Waste accumulation and littering (-)	03	0.9	15.12	13.61
Road degradation and vehicular traffic (-)	02	0.9	10.46	9.41
Noise generation and pollution due to activities (-)	01	0.9	9.23	8.31
Tourism has enhanced scenic beauty (+)	98	0.98	12.04	11.79
Promoted cleanliness and hygiene (+)	98	0.98	17.09	16.75
Encourages measures for the conservation of woodlands and wilderness areas (+)	99	0.99	18.12	17.94
Promoted more plantation and environmental awareness programs (+)	99	0.99	17.92	17.74
Total carrying capacity impact unit for ecological aspect	-	-	-	95.5

Notation:(+) Indicates positive impact indicator; (-) indicates negative impact indicator (n=123)

Table 5: Indicator quality unit and carrying capacity impact unit of social carrying capacity component

Social Impact Indicators	Stakeholder agreements (%)	IQU	PIU	CCIU
Enhanced functioning of local governing institutions (+)	100	1	18.16	18.16
Facilitated contact with the outside world/ culture sharing (+)	99	0.99	17.70	17.52
Tourism has helped in preserving local art and culture (+)	99	0.99	28.94	28.65
Problems caused by locals to visitors' (-)	1	0.9	6.65	5.98
Sufferance to local residents due to overcrowding, pollution, rash driving, water scarcity etc., by the visitors. (-)	1	0.9	8.71	7.84
Locals are losing confidence and cultural identity (-)	0	1	10.44	10.44
Promoted crime, moral laxity/ drugs, eve teasing of local women etc. (-)	4	0.9	9.38	8.44
Total carrying capacity impact unit for social aspect	-	-	-	97.03

Notation :(+) Indicates positive impact indicator; (-) indicates negative impact indicator (n= 123)

Table 6: Indicator quality unit and carrying capacity impact unit of facility carrying capacity component

Facility (infrastructure) impact indicators	Stakeholder agreement (%)	IQU	PIU	CCIU
Water or other natural resource scarcity (-)	01	0.9	30.0	27.0
Site congestion or loss of aesthetic appeal (-)	01	0.9	18.2	16.38
Local's agitation and objections towards tourism in the area. (-)	01	0.9	14.9	13.41
Legal restrictions for construction of hotels and other facility (+)	99.3	0.993	37.0	36.74
Total carrying capacity impact unit for facility aspect	-	-	-	93.53

Notation :(+) Indicates positive impact indicator; (-) indicates negative impact indicator (n=123)

Table 7: Indicator quality unit and carrying capacity impact unit of economic carrying capacity component

Economy Impact Indicators	Stakeholder agreement (%)	IQU	PIU	CCIU
Tourism has created more jobs for the local people (+)	100	1	17.07	17.07
Responsible for additional income (+)	100	1	32.26	32.26
Has improved standards of living of the residents (+)	92	0.92	28.90	26.58
Inflation in price and increased cost of living in and around tourism zone	08	0.9	21.77	19.59
Total carrying capacity impact unit for economic aspect	-	-	-	95.51

Notation :(+) Indicates positive impact indicator; (-) indicates negative impact indicator (n=123)

Table 8: Indicator quality unit and carrying capacity impact unitof visitors' experience carrying capacity component

Visitors' experience impact indicators	Stakeholder Agreement (%)	IQU	PIU	CCIU
Solid waste and littering (-)	13.7	0.8	16.52	13.22
Dust, smoke and noise generation due to traffic (-)	2.3	0.9	21.13	19.02
Loss of aesthetic value (-)	01	0.9	11.80	10.62
Mode of transportation enhanced (+)	87	0.87	16.33	14.21
Tourism facilities (+)	97	0.97	17.31	16.79
Willingness for another visit (+)	99.8	0.998	19.91	16.876
Total carrying capacity impact unit for visitors' experience aspect	-	-	-	90.7

Notation :(+) Indicates positive impact indicator; (-) indicates negative impact indicator (n= 123)

Table 9: Percentage of perceived carrying capacity left for tourism activity in Kerwa tourism area

Component	CCIU value of each component	CIV as given by experts	carrying capacity left for tourism (%)	Carrying capacity declined from the original in each component (%)
Ecological	0.955	25.036	23.91	4.49
Social	0.970	23.67	22.96	4.10
Facility (infrastructure)	0.935	13.83	12.93	6.76
Economic	0.955	14.81	14.14	6.44
Visitors' experience	0.907	25.79	23.39	3.51
Total	-	-	97.33 %	

expert guideline standard set for the impact categorization, the overall carrying capacity considering all the components is in "very low impact on carrying capacity", as it lies in the 81-100 % range. Hence, from the estimation and results so obtained for the Kerwa catchment area, the environment overall is in its healthiest state of art.

CONCLUSION

This study provided a different perspective to this holistic approach, where the tourism carrying capacity assessment method was primarily based on overall perceptions from different stakeholders and experts' opinion. Ranking of relevant indicators and relative importance index for each indicator under each environmental component provides the crucial first tier platform for assessing the TCC of the Kerwa area. The distinct percentage of decrease of each indicator and component were also distinguished through the survey. The results clearly illustrates that the carrying capacity of the Kerwa is still in its infancy stage as the decrease in the percentage of carrying capacity due to tourism activities is under "very low impact" category set. The current total perceived decline in carrying capacity that measures for the tourism activities is found to be 97.33% with a slight decline of 03% from the original. The results therefore obtained can be used as a benchmark for the further evaluation and analysis of the tourism area over a period of time. The major issue that ensued from the survey is that the visitors' experience has been declined most compared to other components of carrying capacity. The other significance of IQU and CCIU value is that it indicates the individual impact indicators agreement among the stakeholders which is further an indicator of the current tourism scenario. The indicators as identified by the experts' like solid waste and visitors' infrastructure have to be taken into consideration in formulating policies for the development of the tourism plan. It is recommended that the policies and strategic models so formulated should consider the identified evaluated impacts and carrying capacity for the destination area.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

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